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ORIGINAL CONTRIBUTIONS

Laparoscopic Sleeve Gastrectomy Following Failed Laparoscopic Adjustable Gastric Banding—a Comparison Between One- and two-Stage Procedures, an Israeli National Database Study

Zvi Perry[1] · **Orly Romano-Zelekha**[2] · **Nasser Sakran**[3,4] · **Itzhak Avital**[1] · **Shahar Atias**[1] · **Uri Netz**[1] · **Boris Kirshtein**[1]

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Abstract

Purpose The optimal revisional bariatric surgery procedure following a previous failed gastric band surgery is yet to be determined. The aim of our study was to compare single- and two-stage laparoscopic sleeve gastrectomy (LSG) following laparoscopic adjustable gastric banding (LAGB) in terms of short- and mid-term outcomes.

Materials and Methods Patients who underwent LSG after a failed LAGB in Israel during 2014–2017 were included. Data were obtained from the Israeli National Bariatric Surgery Registry. Data analyzed included comorbidities, postoperative complications, and anthropometric outcomes.

Results Of 595 patients included in the data analysis, 381 (64%) underwent one-stage and 214 (36%) had two-stage LSG. No differences were observed between the groups in complication rates (5.0 vs. 5.1%, p=0.93). Percent of total weight loss was lower following one-stage than two-stage procedure at both 6 months (19.3±9.3 vs. 21.5±8.1%; p=0.02) and 1 year postoperative (24.9 ±10.4 vs. 27.8±9.9%; p=0.02). No difference was observed in the percent excess weight loss (51 vs. 56%; p=0.34 and 66 vs. 72%; p=0.38, at 6 months and 12 months postoperative, respectively). In a regression analysis, percent excess weight loss was greater in the two-stage procedure (p=0.02), with no difference in the complication rates (p=0.98).

Conclusion Single-step LSG had a similar safety profile as two-stage LSG following a failed LAGB. Better weight loss was seen following two-stage LSG. Further prospective studies should investigate long-term follow-up after one- and two-stage procedure.

Keywords Revisional bariatric surgery · Laparoscopic sleeve gastrectomy (LSG) · Single-stage · Two-stage · Outcomes · Postoperative complications

Introduction

Bariatric surgery is an effective and durable treatment for morbid obesity [1]. Approximately, 252,000 persons underwent bariatric procedures in 2018 in the USA alone [2]. Similarly, Israel has developed an alarmingly high obesity rate, with a rising number of bariatric procedures, similar to trends observed in the USA [3]. Common bariatric procedures include laparoscopic sleeve gastrectomy (LSG), laparoscopic Roux-en-Y gastric bypass (LRYGB), and laparoscopic adjustable gastric banding (LAGB) [4, 5]. LAGB is a minimally invasive, restrictive procedure that has shown efficacy in short- and intermediate-term weight loss, as well as improvement in comorbidities, with a very low early postoperative morbidity and mortality [6]. During the years 2011–2014, more than 100,000 gastric bands were implanted in the USA alone [7]. But LAGB has been reported to be associated with several late postoperative complications [8], including slippage [9], erosion, mechanical malfunction, and band intolerance [10, 11]. Approximately, 40–50% of patients who

Zvi Perry and Orly Romano-Zelekha contributed equally to this work.

✉ Zvi Perry
zperry1@gmail.com

1 Department of Surgery A, Soroka University Medical Center, P.O Box 151, 64101 Beer-Sheva, Israel

2 Israel Center for Disease Control, Ministry of Health, Tel HaShomer, Israel

3 Departments of Surgery A, Emek Medical Center, Afula, Israel

4 Technion – Israel Institute of Technology, Haifa, Israel

undergo LAGB regain weight after 5 years and require another procedure for weight loss [12, 13]. While the precise definition of a failed bariatric procedure remains obscure, it is generally considered as the appearance of early or late complications requiring additional surgical interventions, or insufficient weight loss/weight regain [14]. Another aspect to this definition of failure, specific to LAGB, is a mechanical dysfunction of the band itself. Bariatric procedure failure requires intervention to prevent and treat weight gain and associated morbidity. Revisional bariatric surgery is the fastest growing field in bariatric surgery, and constituted 15.4% of all the bariatric procedures performed in the USA in 2018 [15]. The number of revision procedures performed increased by 19.7% from 32,238 in 2017 to 38,971 in 2018, with an observed 311% increase since 2011.

Gastric band removal only comprised of 27.6% of all revisional procedures [2]. The rate seems to be similar in Israel [16].

The evidence is limited regarding the appropriate revisional surgery following failure of a previous bariatric procedure [17, 18]. Various procedures have been recommended for revisional surgery after a failed band [19–23]. LSG, LRYGB, and laparoscopic duodenal switch (LDS) all are options for revising a failed LAGB [24, 25]. Revisional surgery following LAGB can be performed in either a single- or a two-staged procedure. In a one-stage procedure, the gastric band is removed, together with the performance of the new bariatric procedure's performance in the same operation. In a two-stage procedure, the band is initially removed and the second bariatric procedure is performed in a separate surgery. Some surgeons postulated that a single-stage procedure might be easier for patients, as it entails only one hospitalization and surgery. However, such procedure might pose the risk of a longer, more complex surgery, which involves separation of band adhesions and fibrosis in the upper part of the stomach and gastroesophageal junction and dilated gastric pouch, and often repair of hiatal hernia during performance of the revisional bariatric procedure. This may increase the danger of a postoperative leak by up to 50% [26, 27]. A two-stage procedure, in which the new bariatric procedure is performed 3–6 months after the band removal, has the theoretical advantage of a reduced leak rate. However, this entails another operation with its own risks, including the need to divide new adhesions formed following the band removal, as well as the added costs of another hospitalization and surgery. The current study aimed at comparing the short- and medium-term outcomes of one- and two-staged revisional LSG following LAGB in a large nationwide database.

Methods

All patients aged 18 years and over, who underwent LSG following failed LAGB in Israel between January 2014 and December 2017, were included in the study. Data were obtained from the Israel National Bariatric Surgery Registry, which became a mandatory registry that was initiated in 2013.

Hospitals that perform bariatric procedures are obligated to submit data to this registry monthly in order to maintain privileges and be reimbursed. Currently, 34 Israeli hospitals contribute to this registry. Data were collected using a structured electronic questionnaire, which was transferred to the registry; data quality control is routinely performed. The anonymity of the patients is maintained in the registry database. Data collected included patient demographics, BMI, comorbidities (based on the pre-op surgeon's report), hospital type (public or private), surgery data (surgery type, surgical approach, primary vs. secondary surgery, and length of hospital stay), admission to an intensive care unit, complications according to Clavien-Dindo classification [28], and mortality. We lack data regarding surgical staplers and boogie size using during LSG procedure. One year postoperative follow-up data pooled from the database included percent total weight loss, percentage of excess weight loss (%EWL), short-term complications, additional interventions required, and comorbidities improvement as is reported in other bariatric registries [29]. Mortality data calculated at the end of the follow-up period (December 2018) was obtained by cross-referencing information with the Israeli national population registry. Data regarding band removal were obtained from the bariatric registry for 2/3 of the cases. For the remaining cases, data were completed from the National Hospitalization Registrar. Patients with insufficient data were excluded from the analysis.

Statistical Analysis

Statistical analysis was performed using the SAS software (version 9.1, SAS, Cary, NC). Results were expressed as means ± standard deviation (SD), or as percentages. For continuous variables, differences in means were assessed, using the independent-samples t test. The chi-square test was applied for categorical variables. $p < 0.05$ was considered statistically significant for all analyses. To evaluate variables associated with %EWL 1 year postrevisional surgery in 1 or 2 stages, a multivariate model was conducted.

We initially examined associations between independent variables and the %EWL 1 year after revisional surgery (as a continuous variable) using simple linear regression models. We then performed a multiple linear regression model including variables that demonstrated statistically significant ($p<0.05$) associations with %EWL at 1 year postrevisional surgery, such as age (continuous), population group (Arabs/Jews), hypertension (yes or no), and higher number of comorbidities (0–1, 2–3, >3). The model was also adjusted for BMI prior to surgery and gender, regardless of the statistically significant level of these variables. To evaluate the association between complications during hospitalization and conversion of LAGB to LSG in one or two stages, a multivariate logistic regression model was conducted. The model was adjusted for age, gender, BMI before LSG, and the number of comorbidities.

Results

During the study period, 34,699 bariatric procedures were performed in Israel. Of these, 29,855 (86.4%) were primary and 4721 (13.6%) revisional procedures. Of the latter, 3718 (78.8%) were performed after a failed LAGB, and 1190 (32.0%) of the LAGB revisions were converted to LSG. The patient selection process is depicted in Fig. 1. Of the 595 patients included in the analysis, 381 (64%) underwent a one-stage and 214 (36%) a two-stage revisional LSG for LAGB failure. During the course of the study, the number of two-stage LSG revisional procedures decreased, and the number of one-stage procedures increased (Fig. 2). Of the 214 patients who underwent a two-stage procedure, we had complete data regarding band removal for 174 of them. The mean time between removal of the band and the LSG was 2.35 years (±2.55; with a range of 0.44–10.7 years). When looking at follow-up time, the two groups had similar 6-month follow-up rate (61 vs. 67% in 1 vs. s-staged procedure, p=0.11), 12 months (42 vs. 53% respectively, p=0.01), and 24 months post-LSG (38 vs. 44% respectively, p=0.13).

Regarding previous surgeries, eleven (2.9%) patients who underwent conversion to LSG in one stage and 80 (37.4%) who underwent conversion in two stages had previous non-bariatric abdominal surgery: 9 (4.2%) and 46 (12%), respectively, in the lower abdomen, and 2 (0.9%) and 34 (8.9%), respectively, in the upper abdomen. Demographics, comorbidities, and anthropometrics prior to the revisional surgery are depicted in Table 1. There was no difference in demographic variables including age, sex, ethnic distribution, marriage status, education, and smoking history between those who underwent single- and two-stage procedures. The prevalence of diabetes mellitus, dyslipidemia, and fatty liver disease prior to the revisional surgery were higher in the two-stage group (21.8 vs. 13.6%; p=0.01, 32.2 vs. 24.7%; p=0.05, and 61.2 vs. 49.6%; p<0.01, respectively). Other comorbidities including hypertension, orthopedic issues, sleep apnea, ischemic heart disease, previous stroke, atherosclerosis, and depression were not significantly different between the groups. The mean BMI before revisional surgery and the proportion of

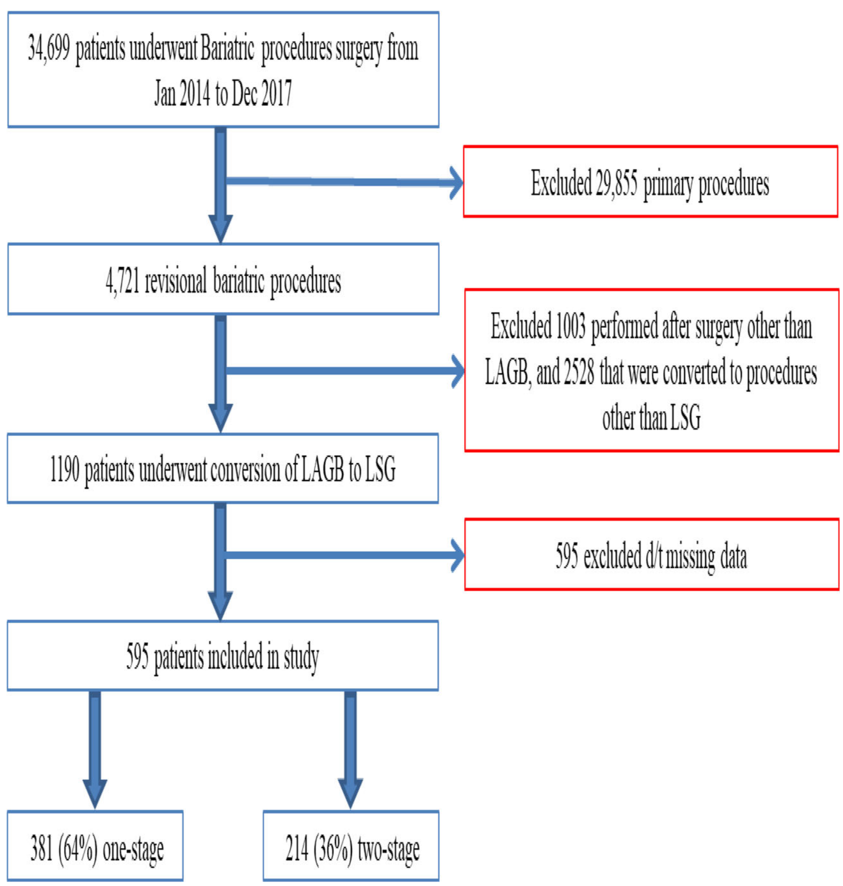

Fig. 1 Flow diagram showing patient selection of individuals who underwent laparoscopic sleeve gastrectomy (LSG) after laparoscopic adjustable gastric banding (LAGB)

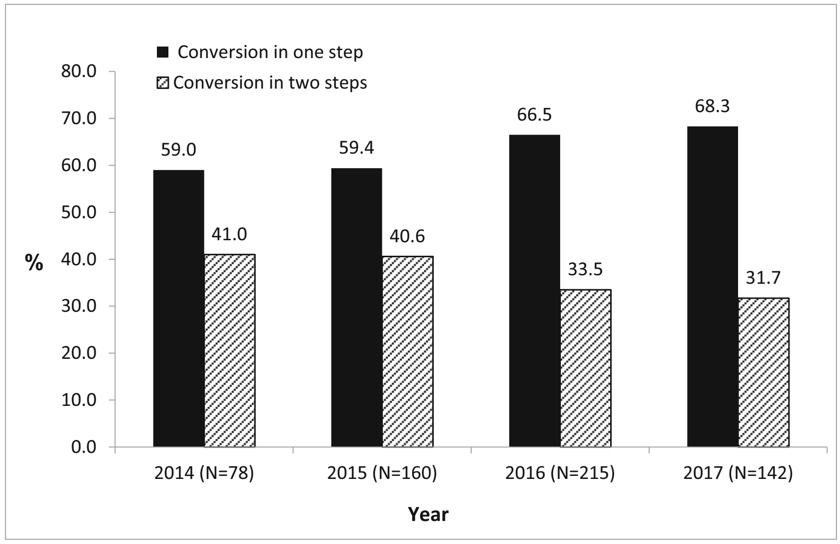

Fig. 2 The prevalence of one-stage and two-stage laparoscopic sleeve gastrectomy revisional procedures during the course of the study period. * No significant change was found across the years (χ^2 =4.1, p=0.25)

Table 1 Demographics, comorbidities, and anthropometrics prior to revisional surgery

	One stage (*n*=381)	Two stage (*n*=214)	*p*
Demographics			
Gender - male, *n* (%)	168 (38.2)	46 (29.7)	0.06
Age during revisional surgery – years, mean ± SD	41.6 ± 11.8	43.4 ± 11.5	0.06
Ethnicity			
Jews, *n* (%)	327 (85.8)	172 (80.4)	0.08
Arabs, *n* (%)	54 (14.2)	42 (19.6)	
Marital status – married, *n* (%)	249 (65.4)	130 (60.8)	0.26
Education - academic, *n* (%)	92 (24.2)	48 (22.4)	0.10
Smoking			
Current smokers, *n* (%)	103 (27.2)	56 (26.4)	0.84
Past smokers, *n* (%)	32 (13.6)	23 (17.2)	
Comorbidities pre-revision, *n* (%)			
Diabetes type 2	51 (13.6)	46 (21.8)	**0.01**
Insulin treatment before surgery	8 (2.2)	8 (3.8)	0.25
Hypertension	83 (22.1)	57 (28.9)	0.19
Orthopedic problems	57 (15.2)	41 (19.4)	0.18
Sleep apnea	29 (7.7)	18 (8.6)	0.71
Ischemic heart disease	10 (2.7)	4 (1.9)	0.56
Dyslipidemia	92 (24.7)	67 (32.2)	**0.05**
Fatty liver disease	184 (49.6)	126 (61.2)	**<0.01**
Previous stroke	2 (0.5)	2 (0.9)	0.55
Atherosclerosis	7 (1.9)	2 (1.0)	0.39
Depression	28 (7.4)	13 (6.2)	0.56
No. of comorbidities, *n* (%)			
0–1	215 (56.6)	99 (46.3)	
2–3	118 (31.1)	77 (36.0)	**0.04**
3<	47 (12.3)	38 (17.8)	
Follow up prior to revision - years, mean ± SD	2.7 ± 0.94	2.8 ± 0.99	0.10
Anthropometrics			
BMI - kg/m^2, mean ± SD	42.1 ± 6.6	44.8 ± 7.0	**<0.01**
BMI ≥ 50, *n* (%)	48 (12.6)	47 (22.1)	**<0.01**

The numbers in bold is the statistical significance (p<0.05) patients with a BMI >50 kg/m^2 were significantly higher in the two-stage than the one-stage group (44.8±7.0 vs. 42.1±6.6 kg/m^2; p<0.01 and 22.1 vs. 12.6%; p<0.01, respectively). There were no differences in the indication for revisional surgery, type of hospital, or surgical approach between the groups. Also, the revisional surgery complication rates, type, and severity (according to the Clavien-Dindo classification [28]) were not statistically different between the groups. Length of stay, ICU admissions, and mortality rates were also similar. Table 2 shows the revisional surgery data and complications. Overall morbidity including readmissions was equal between two groups: 10.5% in one stage vs. 11.7% in two stages revision (p=0.19). Thirty-day readmission rates were similar following one-stage and two-stage procedures: 5.8% and 7.0%, respectively (p=0.55). Table 3 shows the causes for readmission according to ICD-9 coding. We compared anthropometrics between the groups at 6 months, 1 and 2 years postrevisional surgery (Table 4).

The %TWL and BMI units lost were greater following the two stage procedures at both 6 months (p=0.02 and p<0.01, respectively) and 1 year postoperative (p=0.02 and p<0.01, respectively), a difference that became non-significant at 2 years (p=0.46 and p=0.15, respectively). No difference was seen in percent excess weight loss (%EWL) between the groups. In a multivariate linear regression model, we found age, BMI prior to LSG, history of depression, and a two-stage procedure to be associated with excess weight loss at 1 year postrevisional surgery (Table 5). In patients with a 2-year follow-up, we have run a multivariate linear regression model that has shown that only prior BMI and hypertension were associated with excess weight loss (Table 6). In a linear regression model, neither the two-stage procedure nor any of the other variables examined was found to be associated with an increased risk for complications during hospitalization (Table 7).

Table 2 Revisional surgery data and complications

	One stage (n=381)	Two stage (n=214)	p
Indication for revision, n (%)			
Weight gain	379 (99.5)	213 (99.5)	0.92
Complication of band	2 (0.5)	1 (0.5)	
Type of hospital, n (%)			
Public	206 (54.1)	104 (48.6)	0.19
Private	175 (45.9)	110 (51.4)	
Surgical approach, n (%)			
Laparoscopic procedure	380 (99.7)	213 (99.5)	0.67
Open procedure	1 (0.3)	1 (0.5)	
Laparoscopic converted to open	0	0	
Total complications, n (%)	40 (10.5)	25 (11.6)	0.19
Type of complication, n (%)			
Bleeding	7 (1.8)	5 (2.3)	0.67
Sepsis	0	0	-
Surgical site infection	1 (0.3)	0	0.45
Leak or abscess	5 (1.3)	5 (2.3)	0.35
Venous thromboembolism	2 (0.5)	0	0.28
Cardiac - respiratory	6 (1.6)	2 (0.9)	0.51
Clavien-Dindo classification, n (%)			
1	5 (1.3)	4 (1.9)	
2	4 (1.0)	3 (1.4)	
3	7 (1.8)	4 (1.9)	0.84
4	0	0	
5	1 (0.3)	0 (0)	
Length of hospital stay of LSG surgery – days, mean ± SD	3.0±2.4	3.7±7.4*	0.19
Readmissions 30 days after surgery due to any reason, n (%)	21 (5.5)	14 (6.5)	0.55
Hospitalization in intensive care, n (%)	6 (1.6)	3 (1.4)	0.86
Mortality n (%)	2 (0.5)	2 (0.9)	0.55

The numbers in bold is the statistical significance (p<0.05)

* The higher average days of hospitalization results from one patient who was hospitalized for 3 months

Table 3 Causes of 30-day readmissions, according to ICD 9 codes, following revisional LSG

Complication (ICD-9 coding)	One stage *n*=21/381 (5.5%)	Two stages *n*=14/214 (6.5%)
Hematoma complicating a procedure	2	
Abdominal pain unspecified site (78900)	4	2
Anemia unspecified (2859)	1	
Choleperitonitis (56781)	1	
Unknown (000000)	3	3
Benign intractable hypertension (3482)	1	
Vomiting alone (78703)	1	
Esophageal reflux (53081)	1	
Peritoneal abscess (56722)	1	1
Abdominal pain epigastric (78906)	1	
Postprocedural fever (78062)	2	
Pneumonia organism unspecified (486) and vomiting post-surgery (5643)	1	
Other complications of bariatric procedure (53989) no details	2	
Nausea with vomiting (78701)		1
Peritonitis unspecified (5679)		1
Nausea alone (78702)		1
Headache (7840)		1
Dysphagia unspecified (78720)		1
Other postoperative infection (99859)		1
Malaise and fatigue (7807)		1
Gastrointestinal hemorrhage unspecified (5789)		1

The numbers in bold is the statistical significance (p<0.05)

Discussion

Our study, based on a national bariatric surgery registry, presented 595 patients who underwent revisional sleeve gastrectomy after a failed gastric band. The mean time between band removal and LSG was 2.4 years. These revisional surgery patients required weight loss to decrease morbidity, comorbidities, and complication rates. Our results have shown

Table 4 Anthropometrics following LSG revisional surgery

	One stage, mean ± SD	Two stage, mean ± SD	*p* value
6 months post-LSG	N=231	N=144	
* %EWL	50.8 ± 27.7	55.5 ± 66.9	0.34
** %TWL	19.3 ± 9.3	21.5 ± 8.1	**0.02**
*** BMI units lost	8.3 + 4.5	9.7 + 4	**0.001**
12 months post-LSG	N=159	N=113	
%EWL	65.5 ± 30.2	71.8 ± 74.0	0.38
% TWL	24.9 ± 10.4	27.8 ± 9.9	**0.02**
BMI units lost	10.7 + 5.2	12.5 + 5.2	**0.004**
24 months post-LSG	N=143	N=94	
%EWL	65.0 ± 42.0	58.5 ± 25.0	0.1419
% TWL	24.18 ± 11.45	25.30 ± 11.12	0.4610
BMI units lost	10.50 ± 5.07	11.59 + 5.58	0.1457

The numbers in bold is the statistical significance (p<0.05)

[*] %EWL - the excess weight was initially calculated as the weight above the patient's ideal body weight defined as a BMI of 25 kg/m^2

[**] %TWL was calculated according to the ASMBS guidelines, as [(Initial Weight) – (Postop Weight)]/[(Initial Weight)]*100

[***] The change in BMI was calculated as the difference between the initial and the final BMI

Table 5 Multivariate linear regression model of factors associated with excess weight loss 1 year after revisional laparoscopic sleeve gastrectomy (n=266*)

Parameter	β	p value
Age (years)	−0.7	**0.02**
Gender (male)	−2.3	0.76
Population group (Jews compared to Arabs)	15.7	0.09
BMI before LSG	−2.2	**<0.01**
No. of comorbidities (0–1, 2–3, >3)	−4.1	0.42
Hypertension	−7.1	0.44
Depression	26.3	**0.02**
Two-stage revisional surgery (compared to 1 stage)	15.4	**0.02**

The numbers in bold is the statistical significance (p<0.05)

* Included all patients with excess weight loss data available at 1 year

that the patients who underwent a two-stage procedure had similar complication rates. The leak rate for the entire cohort was 1.7%, with no difference between groups. This is an acceptable rate for this type of procedure [30]. The mean BMI and percent of patients with a BMI above 50 kg LSG was higher in the 2-stage, but the %EWL did not differ between the groups. The postoperative improvement in comorbidities was similar. The proportion of two-stage procedures decreased over the years, likely the result of increased proficiency gained by surgeons in performing a single-stage procedure.

As reported in the literature over the years, the safe and comparable results between the two approaches may have contributed to the decline in the number of two-stage compared to one-stage procedures performed, as seen in the current study. A similar safety profile was observed for both revisional procedures. Although this may be a result of a selection bias, other studies have shown this trend. In a study published by Mognol et al. [31], revision of a band to bypass procedure was demonstrated to be both feasible and safe. Other studies demonstrated that revision of a band to a bypass is as safe as a primary bypass procedure, despite longer operating times [32, 33]. Al-Kurd et al. [27, 34] reported that one- and two-stage band to bypass procedures were equally safe, with comparable weight loss profiles. And yet, many surgeons still prefer the 2-stage procedure for revision of bands to bypass [35]. As LSG became more popular, revisional LSG following failed banding was also introduced, with results comparable to those of revisional bypass surgery [36]. Silecchia et al. [37] reported safe and similar results of 76 revisional LSG procedures performed in 2 stages compared to 184 patients with primary LSG procedures. In a registry-based study, Stroh et al. [38] reported higher leak rates following a single-stage procedure; however, their two-stage group comprised of only 37 patients, making null hypothesis rejection less likely. Obeid et al. [39] found similar short-term results between one-stage and two-stage conversions of band to LSG, but the sample size was small. In a meta-analysis of revisional surgery after LAGB, Dang et al. [40] included results from LSG and bypass procedures; and they concluded that the specific effect of a prior band on a single- vs. two-stage LSG is similar.

Table 6 Multivariate linear regression model of factors associated with excess weight loss 2 years after revisional laparoscopic sleeve gastrectomy (n=236)

Parameter	B	p value
Age (years)	−0.26	0.2630
Gender (male)	−1.38	0.798
Population group (Jews compared to Arabs)	1.48	0.815
BMI before LSG	−1.08	**0.0008**
No. of comorbidities (0–1,2–3,>3)	2.51	0.489
Hypertension	−13.81	**0.033**
Depression	−5.47	0.5796
Two-stage revisional surgery (compared to 1 stage)	−1.7	0.7237

The numbers in bold is the statistical significance (p<0.05)

Indications for band revision in our study were mainly related to weight loss failure in both groups. Severe adhesions, difficult anatomy, and crunchy or inflamed tissue in upper stomach region may cause abortion of one-stage to two-stage procedures.

One case of band erosion was included in the 2-stage technique. Usually, eroded band causes surrounding inflammation, tissue thickening, and infection.

When trying to decide whether to perform a one-stage or a two-stage revision of band to LSG, the main question that is crucial involves the complication rates. Following longstanding gastric banding, the surgeon may encounter severe fibrosis and upper gastric pouch dilatation with omental adhesions and changes of the gastric wall in the upper abdomen; these require meticulous dissection during initial band removal. The thickness of the upper abdomen's gastric wall during the one-stage procedure may be increased [19], requiring larger staples during LSG. Unfortunately, we do not have information regarding stapler sizes in our study. During two-stage LSG, these changes are less prominent, and dissection may be easier, as some adhesions were separated in the first stage, and the foreign body (band) was removed; however, in many cases, new adhesions form. Also, there are different techniques of initial band placement. In the early 90th, band was fixed using gastro-gastric sutures. Later on, these stiches were avoided and band was inserted through pars flacida. It was fixed by surrounding fibrotic tissue growing during first month. Knowing the anatomy and the type of initial LAGB surgery before one stage or first step revision is essential to plan the surgery and revision of gastric plication and prevent gastric perforation during tissue dissection. Removal of fibrotic capsule in the band "bed" on the stomach wall is another maneuver that should be done during initial revision. However, it does not prevent changes and adhesions in the

Table 7 Odds ratio for complications during hospitalization following LSG (n=594 *)

Parameter	Odds ratio (95% CI)	p
Age (years)	1.0 (0.99–1.10)	0.11
Gender (male)	1.4 (0.63–3.13)	0.39
BMI before LSG	0.99 (0.93–1.05)	0.64
No. of comorbidities (0–1,2–3,>3)	1.2 (0.72–2.12)	0.42
Two-stage revisional surgery (compared to 1-stage)	1.0 (0.46–2.22)	0.98

The numbers in bold is the statistical significance (p<0.05)

* Included in the analysis all patients who had complete data regarding the regression analysis

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upper part of the stomach during the second stage of revisional procedure.

The main limitation of the current study is the retrospective design. Consequently, half of the patients who were operated during the study period were excluded from the incomplete data analysis.

Thus, we lack the weight before the primary band surgery, which might have an impact the results of the primary surgery and the indication for the revisional surgery. We also lack the data regarding body weight and BMI at the time of band removal for the two-stage procedure. Another limitation is that we could not control for prior abdominal surgeries, due to the small number of patients with prior operations. This calls for a larger sample size. Since our study was based on a national registry, a multi-national study seems in order.

Conclusions

LSG revision of a failed LAGB as a single-stage procedure is feasible and has similar perioperative morbidity and medium-term results. A one-stage revision can decrease the number of surgical procedures and saves operating room time and resources. Although the two-stage approach has been advocated due to the expectation of a better safety profile, this was not seen in our study. Weight regain and increased incidences of comorbidities such as diabetes and dyslipidemia during waiting time for the second stage are additional potential disadvantages of the two-stage band revision. As is generally recognized, the choice of procedure should consider the experience and discretion of the surgeon, as well as the characteristics and desires of the patient. Further studies are warranted to evaluate the long-term efficiency of the two procedures.

Declarations

Ethics approval and consent to participate The study was approved by the regional ethics board. Due to the retrospective design and the anonymity of the data collected, patient informed consent was not required.

Conflict of Interest The authors declare no competing interests.

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